

Several mechanisms have been proposed to explain the corrosion-protective properties of zinc-rich base coatings. The zinc particles act as sacrificing anodes which must be closely packed in order to make the film conductive.^{1 2} Results of early work showed that a very high pigmentation level was required for electrical contact between adjacent zinc particles and between zinc and the steel substrate to provide steel with an initial short-lived period of cathodic protection. The subsequent loss of cathodic protection has been associated with either a loss of zinc-steel contact or with a build-up of zinc corrosion product on the surface of the zinc. Long-term protection is attributed to either zinc corrosion products blocking the pores in the coating and preventing access of corrosidents to the steel, or to deposition of corrosion inhibitive zinc salts on the steel substrate. Zinc is also able to neutralise the acid agents. Some types of zinc dust have a plate-like structure and thus also contribute to the barrier function of the coating. The purpose of this study is to examine the initial short-lived cathodic protection activity of four commercial zinc-rich paints based on epoxy binder. The specimens were steel panels coated with zinc-rich paints (z.r.p.) without a conventional topcoat. The EIS spectrum and the open circuit potential (OCP) of painted steel electrodes were determined as a function of exposure time in aerated 0,1 M sodium-chloride solution at 25 °C. EIS spectrum and OCP were measured after 2, 8, 24, 48, 96 and 168 hour of pre-exposure, using an SI 1287 potentiostat and SI 1255 frequency response analyser with Zplot and Zview software's. The zinc content and type of binder for the four z.r.p. investigated are given in Table 1. The open circuit potential of the painted electrodes after a short time shift in the region of -1 V indicating good electronic contact between zinc dust and steel, since this value is similar to that measured for metal zinc in the same solution. Figure 1. The observed potential rise was not due to loss of zinc-steel contact since scratching the coating surface immediately restored the original negative potential except paint D with low zinc concentration. Figure 2A and Figure 2B show the equivalent electronic circuits for the coating of paints A, B, C and paint D respectively. The process represented by a parallel combination of CPE R1 at high frequencies ($> 10^4$ Hz) is attributed to the properties of coatings. At lower frequencies (> 10 Hz) the response may be attributed to the OH⁻ or O₂ transport in the coatings of paints A, B and C represented by Ws. The calculated parameters are given in Table 2.

¹ Theiler, F., Corrosion Sci ., 1974, **14**,405.
² Ross, T. K., Corrosion Sci. 1977, **17**, 341.

Table 1

Code	Binder	Zinc content % m/m
A	epoxy	85,2
B	epoxy	87,9
C	epoxy	89,0
D	No information	57,0

Figure 1.

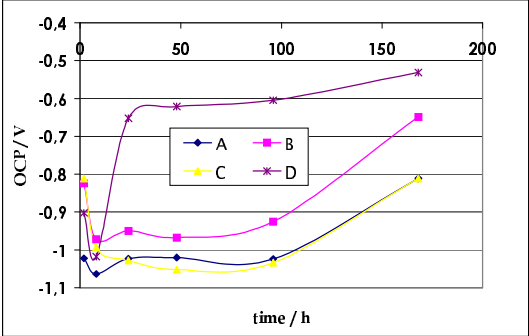


Figure 2A.

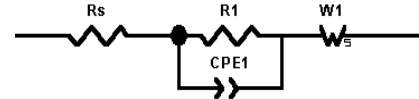


Figure 2B

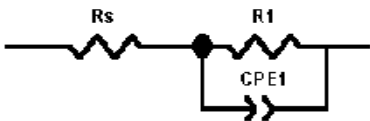


Table 2.

time / h	Rc / Ω	CPE-T / nF	CPE-P	W-R / Ω	W-T / s	Ws-P
A						
2	33330	3,5	0,615			
8	4556	111,8	0,626	13157	0,65	0,337
24	1981	151,0	0,626	6616	0,74	0,292
48	454	201,0	0,691	2319	3,03	0,448
96	251	141,5	0,632	2197	2,97	0,508
168	292	285,7	0,578	3000	3,31	0,502
B						
2	2570900	5,5	0,931			
8	339115	167,3	0,932			
24	99835	417,4	0,852	148530	2,46	0,261
48	18896	628,0	0,833	138200	29,98	0,363
96	7748	814,0	0,784	83067	47,76	0,303
168	10233	2078,2	0,753	21975	0,26	0,200
C						
2	2786500	3,0	0,948			
8	25270	28,7	0,888	45513	0,73	0,363
24	2885	223,1	0,858	14205	0,88	0,316
48	2567	391,5	0,806	4765	0,07	0,386
96	1621	348,3	0,753	3927	8,63	0,421
168	3177	410,8	0,728	3065	4,35	0,412
D						
2	169625	5,9	0,901			
8	369035	11,1	0,889			
24	4396700	15,9	0,815			
48	6239950	19,8	0,704			
96	13577500	21,3	0,720			
168	1192800	18,1	0,717			